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ABSTRACT

Economics of scale for public colleges and universities in Virginia and 22 major public universities were determined by regression analysis. The institutions were analyzed in terms of the number of full-time equivalent students and costs. Results indicate that economies of scale are not necessarily a function of the type and size of a university. No economies of scale appeared as complexity or size of institution increased. It is suggested that it is not realistic to base faculty and financial allotments on ratios reflecting economies of scale. The literature on organizations and finance in higher education is cited. (SW)

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ECONOMIES OF SCALE IN HIGHER EDUCATION

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ECONOMIES OF SCALE IN HIGHER EDUCATION

Introduction

In recent years financial studies in higher education have increased in number. These studies have been stimulated by a tendency toward centralization of control and shrinking dollars. A majority of these financial studies have addressed program costs, perhaps a reflection of the influence of NCHEMS and the need for standards. A major emphasis of these studies has been on per student costs as a means of comparing programs or of determining economies of scale.

In their longitudinal study of revenues and expenditures in institutions grouped by control (public and private) and curriculum (universities, four-year colleges, and two-year colleges) Froomkin, Stump, and Tammany (1972) pointed out that from 1965-66 through 1969-70 comparable institutions of the same type and size often varied as much as four to six times in their expenditures per student.

Dukeit (1974) reported total, per capita, and percent distribution of revenues and expenditures in 1973-74 for institutions grouped by control (public and private) and curriculum (universities, four-year colleges, and two-year colleges). His data showed public two-year colleges to differ from all other groups by per capita costs and percent distribution of revenues by source and expenditures by function. Within public two-year colleges, he found variations in those same distributions in three subgroups based upon size.

Within this framework of financial studies, there has been an increasing concern about "economies of scale." Regardless of size, every college

must maintain a minimum administrative unit as well as minimum library staff, services, and holdings. However, as enrollments increase overall costs in these two areas increase, but sometimes at a slower rate than enrollments (Hawley, Boland, and Boland, 1965; Corrallo and O'Conor, 1973; Scales, 1969). Mathematicians might theorize that such a relationship would result in the proportion of expenditures for administration and library decreasing as enrollments increase. Studies of economies of scale by the Carnegie Commission on Higher Education (1972) and Jordan (1965) indicate that the mathematician would be correct. Their findings indicate that as enrollment size increases, per capita expenditures for both administration and libraries decrease, thus creating economies in the operation of larger community colleges. Institutions which are large enough to establish centralized administrative units, secretarial pools, uniform library holdings, and other cost saving structures can reduce the proportion of expenditures in these two functional areas. Economies can be realized in larger colleges; however, one question continues to linger: how large can an institution become before these economies either cease to exist or they jeopardize qualitative concerns? Hickox and Burston (1973) indicate that there is no optimum size, while the Carnegie Commission (1970) suggests an optimum size of 2,000 to 5,000 students without adequate supportive data. The Carnegie Commission on Higher Education (1972) compared various classes of educational and general expenditures per full-time equivalent (FTE) student within specific groups of institutions. While the Carnegie Commission made numerous general statements supporting the concept of economies of scale, they relented with the following closing statement:

> The fact that overall economies in educational costs per FTE students with increasing size are not nearly so clearcut appears to result chiefly from the tendency for institutions--especially universities, comprehensive universities and colleges--to become more complex and to add relatively expensive fields of study as they grow in size. And, as we have seen, in some groups of institutions, faculty salaries tend to rise with increasing size--another factor working against economies of scale. (The Carnegie Commission on Higher Education, 1972, pp. 188-189)

Hawley, Boland, and Boland (1965) surveyed all four-year institutions in 1961 and indicated that enrollment size was highly correlated ($r = .94$) with expenditures for instruction. They found that as size increased, so did organizational complexity (as measured by administrative levels in the governance structure and by the number of departments and programs offered by the college) and centralization of control (as observed in standardization and uniformity of program structures).

There are a multitude of theories and research efforts discussing formal organizations (Etzioni, 1961; March, 1965; Simon, 1952; Weber, 1947). A more recent effort by Blau (1974) tends to reinforce many of the theories espoused through the years. He clearly tends to dispel the validity in simplistic approaches to economy of scale in organizations. Blau reports on three research projects, sponsored by the National Science Foundation, analyzing the relationships between characteristics of organizations. He reports that in simple organizations operating costs tend to drop significantly as the size of the organization increases. However, as organizations grow in size, they tend to become more and more complex. Blau (1974) states: "Simple agencies exhibit an economy of scale, whereas complex ones do not. Whether the division of labor or professionalization is taken as the indication of structural complexity, larger organizations tend to operate at lower costs than smaller ones if their structure is simple, but not if it is complex." (p. 238)

As if he were intent upon substantiating the Carnegie Commission on Higher Education (1972), Blau (1974) states further:

> If the division of labor is rudimentary . . . operating costs tend to decline with expanding size regardless of the management hierarchy but if the division of labor is advanced, costs tend to rise with expanding size unless the hierarchy is centralized . . . a centralized hierarchy is not a suitable coordinating mechanism for a professional staff. (p. 240)

The relevance of these deliberations on savings through size is not lost to state agencies and legislatures. For example, the Virginia House of Delegates passed a resolution in February, 1978, which requested the State Council of Higher Education for Virginia to consider faculty/student ratios based on the size of institutions of higher education in its budget guidelines for such institutions. The resolution suggests that smaller institutions may need a higher ratio of faculty to students because of their size. The resolution therefore implies that larger institutions should experience sufficient economies of scale to permit graduated funding ratios based upon size. This represents a rather simplistic view which certainly requires further investigation.

Research

Regression analysis was used to determine if there were economies of scale for two groups of institutions: the public colleges and universities in Virginia and 22 major public universities. In each case some form of cost was related to the number of FTE students. The resources to size relationships were described by equations of the form:

$$\text{Resources} = F_o + F_1 \times \text{size} + F_2 \times \text{size}^2$$

Any economy of scale would show itself in the "F_2" term. If larger size implied greater efficiency, F_2 would be a negative number. Conversely, if

F_2 were a positive number, it would imply that it required more resources per student with more students. A zero F_2 would imply no economy/diseconomy of scale.

Virginia Institutions

The Virginia public institutions were analyzed in terms of FTE faculty and students as well as costs per student. The State Council of Higher Education for Virginia provided the FTE faculty data. The student and expenditure data were taken from The Virginia Plan for Higher Education: A Progress Report - 1977.

Thirty-two public state colleges and universities, including both two- and four-year institutions, were used to investigate economies of scale in terms of FTE faculty and students. The results of fitting the model:

$$\text{FTE faculty} = F_o + F_1 \times \text{FTE students} + F_2 \times \text{FTE students}^2$$

showed that F_2 was not significantly different from zero, thus indicating the lack of an economy of scale. The model had a very good fit with an R value of .988 (Figure 1).

Twenty of the public institutions in Virginia were used to test for economies of scale in costs per FTE student. This group consisted of five doctoral-granting universities, nine four-year institutions, and a sample of six two-year colleges. The five cost categories used were the following: Instruction, Administration and General Expenses, Library, Physical Plant, and Total Expenditures.

The attempt to fit a model of the form:

$$\text{Expenditures} = F_o + F_1 \times \text{FTE students} + F_2 \times \text{FTE students}^2$$

to each of the five categories indicated that there was no significant F_2 for any of them (Figure 2). Therefore, it can be concluded that no economies

of scale exist between number of FTE students and these institutional expenditures.

Major Public Universities

Expenditure data and FTE student enrollment were obtained from 22 major public universities for use in predicting expenditures as a function of FTE students on a national level. Six expenditure categories (Instruction, Student Services, Institutional Support, Operation and Maintenance of Plant, Libraries, and Total Expenditures) were regressed on FTE students and FTE students squared. All six of these expenditure categories lacked a significant squared term in models with R values ranging from .54 to .84 (Figure 3). Once again, there was no indication of economies of scale in expenditures per FTE student.

Conclusion

These results indicate that economies of scale are not necessarily a function of the type and size of a university. In this study many types of institutions were compared and a large range of sizes were included. No economies of scale appeared as size increased or as complexity increased. This supports the opinion that it is not realistic to base faculty and financial allotments on ratios reflecting economies of scale.

Overall, both the literature on organizations and that on finances in higher education tend to arrive at the same conclusion with regard to economy of scale. Specifically, the literature indicates that economies are not simple measures related to size alone; organization complexity tends to counteract the impact of size. While this research does not include a measure of complexity, it supports the conclusion that there are

no economies of scale in the samples investigated.

In institutions of higher education, particularly comprehensive universities, there is a tendency to locate more and higher cost programs, thus creating an almost natural complexity. Extend this tendency to a comprehensive land-grant university where emphasis upon the sciences and engineering require expensive and current technology and lower faculty-student ratios. The tripartite mission of instruction, research, and public service adds further dimensions to the complexity of a comprehensive land-grant university. It might be far more defensible, therefore, to suggest that large, complex colleges and universities receive richer ratios than small, simple colleges and universities. It would seem far more appropriate, and far less expensive, however, to maintain the current posture of providing equivalent ratios by level and discipline.

A caution by Wattenbarger and Cage (1974) is worth repeating:

> . . . cost analysis studies are not an end in themselves, but only one of the many tools available to the administrator in his decision-making processes. While cost studies are helpful to explain and justify budgetary demands, judgement is an important part of the process. Decisions have to be made on how to distribute each overhead cost more equitably, how to develop the best estimate for the distribution of personnel time, and what exceptions to the established rules are justified. Familiarity with the general philosophy of the system under study is necessary before judgements can be made, especially when considering the relationship of the purposes of expenditures to the method of distributing them. (pp. 52-53)

This requirement for familiarity with the systems of higher education should be stressed to those who are swayed by the parsimony of simplistic "economy of scale" arguments.

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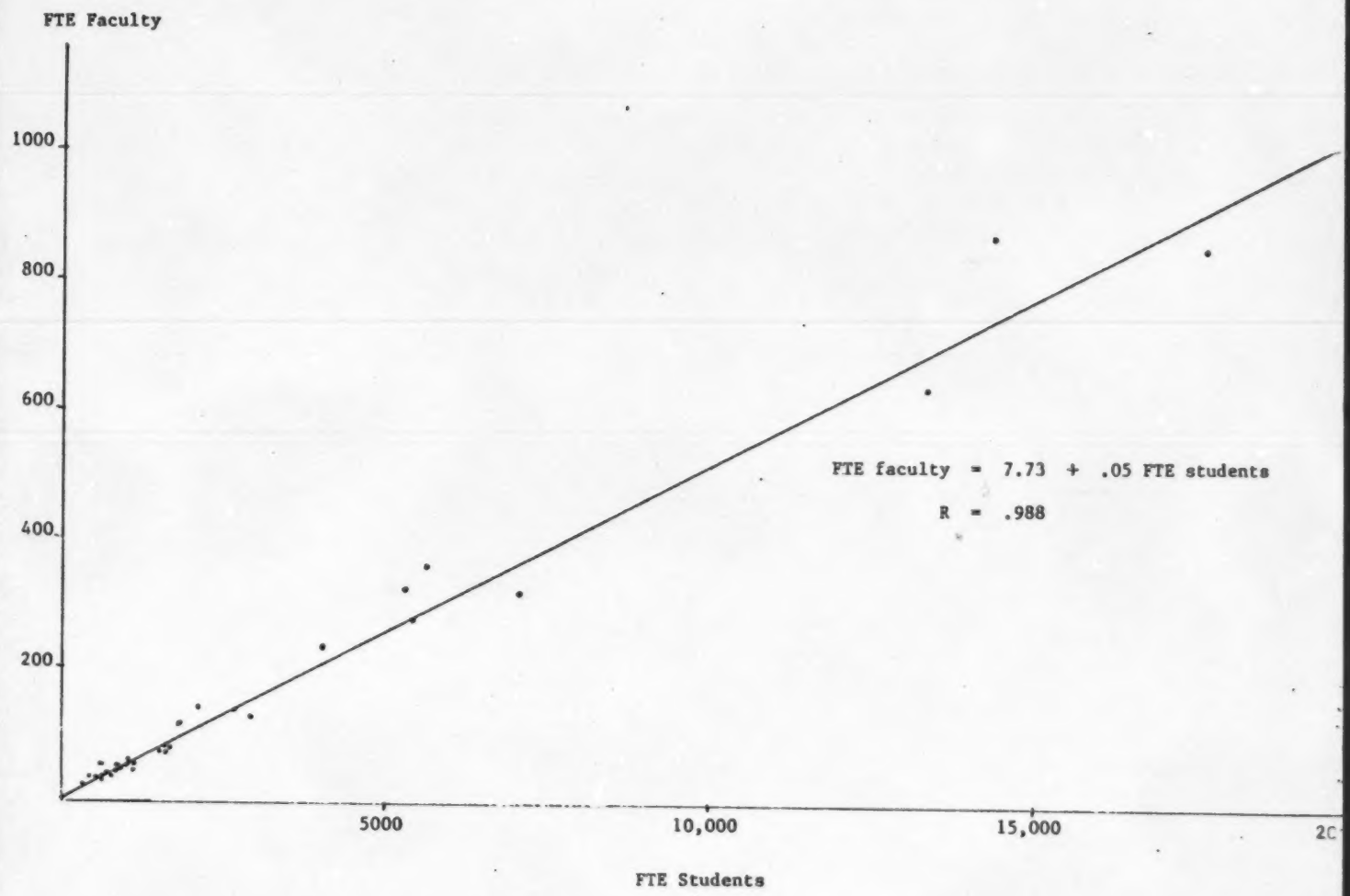

Figure 1. FTE Faculty as a Function of FTE Students for 32 Virginia Colleges (1975-76).

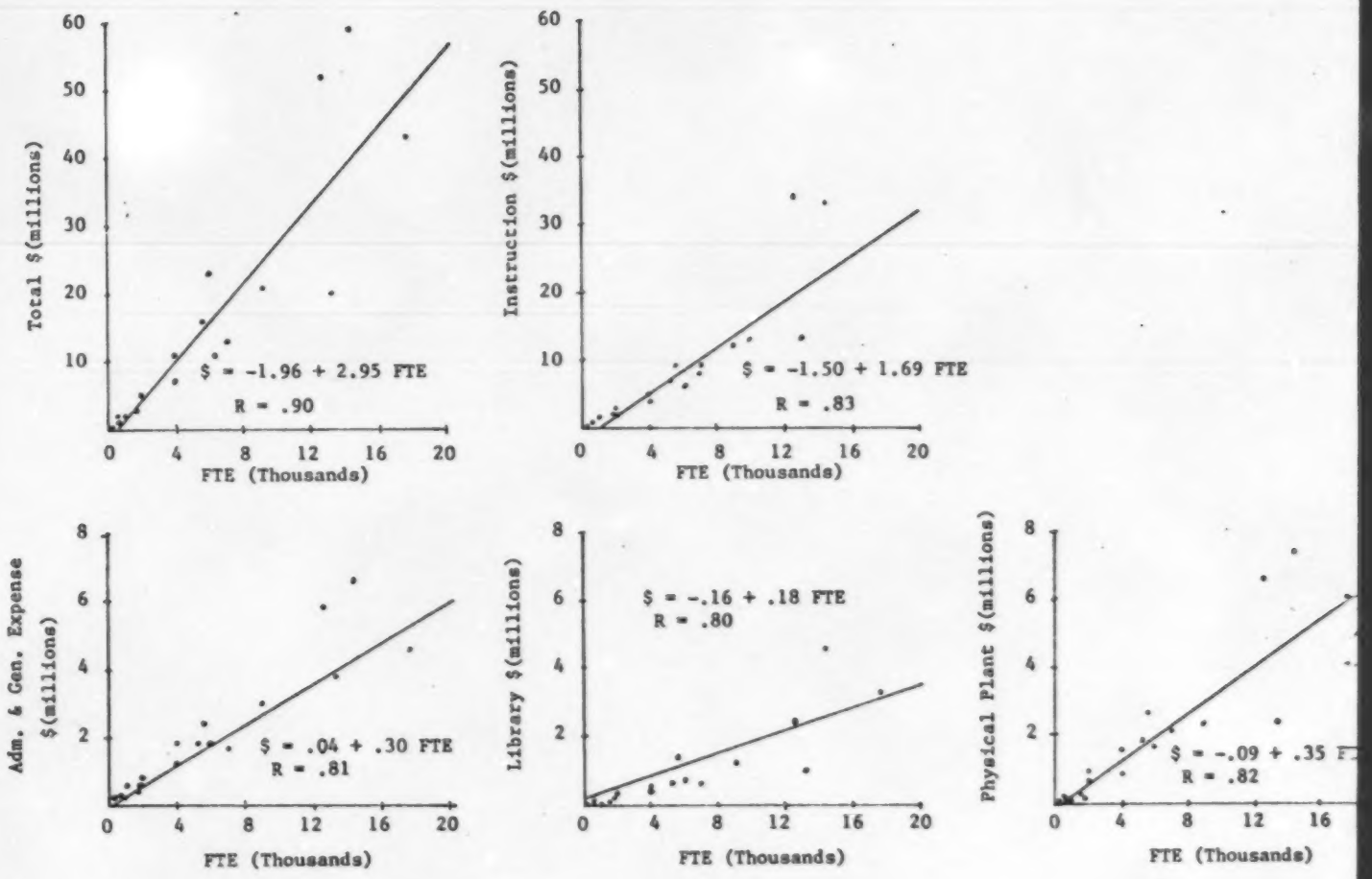

Figure 2. Expenditures as a Function of FTE Students for 20 Virginia Colleges (1975-76).

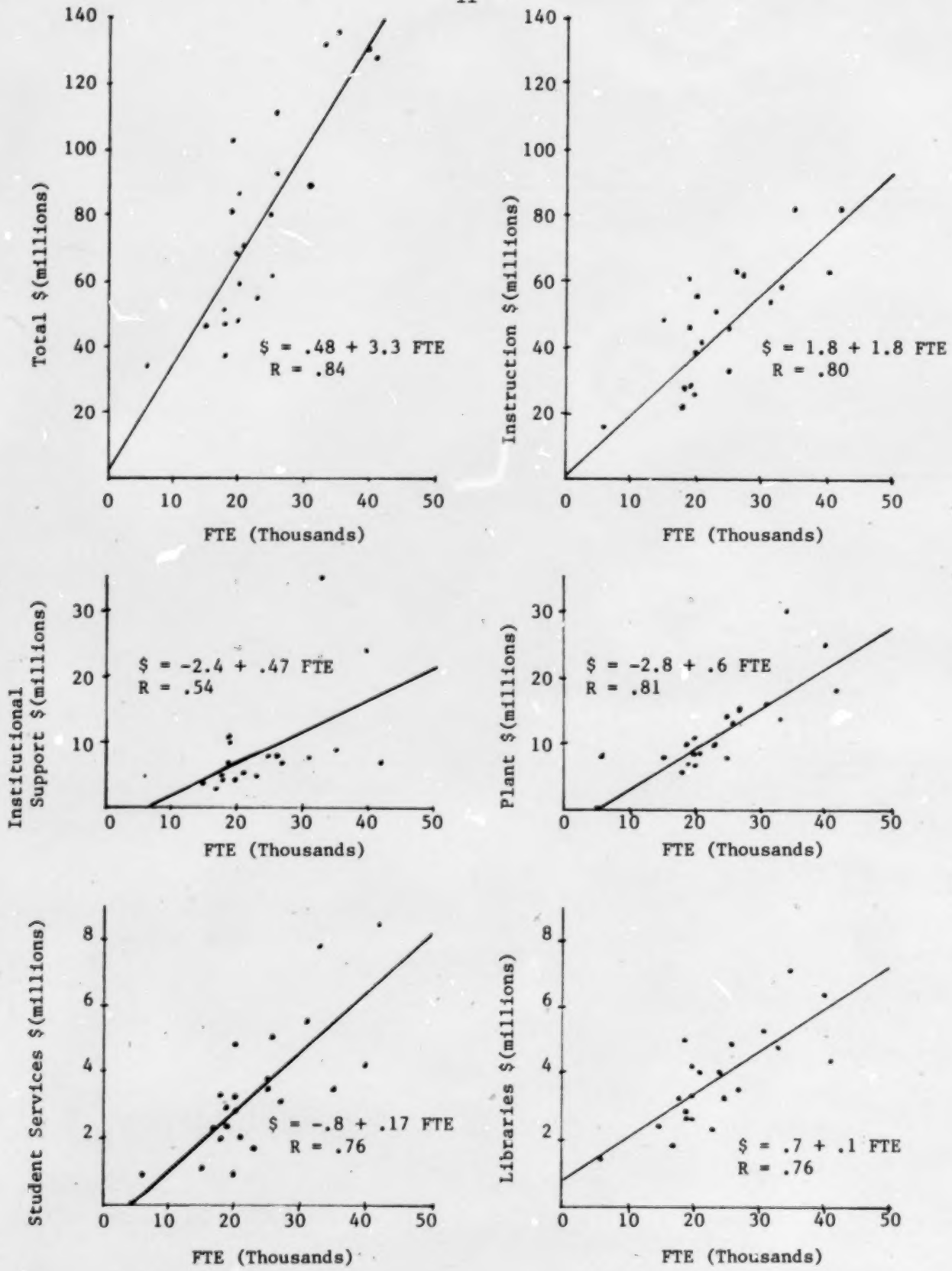

Figure 3. Expenditures as a Function of FTE Students for 22 National Universities (FY ending 1976).